REMARKS

Claims 1 and 3-20 are pending in the application. No claims have been amended or added. Applicants believe that this response addresses the Examiner's rejection and that any changes do not introduce new matter into the specification, limit the scope of the claims or result in any prosecution history estoppel.

Claim Discussion – 35 U.S.C. §102(b)/Utagawa

The Examiner rejected claims 1, 3-6 and 13-20 under 35 U.S.C. 102(e) as being anticipated by Utagawa (U.S. Pat. No. 6,563,538). Applicants respectfully disagree with the Examiner's rejection. In particular, Utagawa fails to teach or suggest "computing a color signal includes relatively weighing the pixel signal values by *relatively weighing more heavily the pixel signal values associated with the direction increasing less relatively in pixel signal value level for the particular pixel location* and computing the color signal value based upon contributions from both directions" as claimed or similarly claimed.

As noted in the specification on page 6, first paragraph to page 8:

> "As illustrated in Fig. 1, the immediately adjacent pixel locations in the horizontal and vertical directions comprise green pixel signal values. Therefore, these shall be employed to estimate the green pixel signal value for this particular pixel location. First, the relative change in the green pixel signal values for the horizontal direction and the vertical direction across this particular pixel location is computed and compared. This is accomplished using the following equations.
>
> $$Chor = G_{m,n+1} - G_{m,n-1};$$
> $$Cver = G_{m+1,n} - G_{m-1,n};$$
>
> If the relative change in the vertical direction is greater than the relative change in the horizontal direction, the relative change being relative to the magnitude of the values computed above, then the values in the horizontal direction, that is, **in this embodiment, the green pixel signal values that are the immediately adjacent pixel signal values in the horizontal direction, are weighed more heavily. In this embodiment, the weight assigned to horizontal green pixel values have been chosen, based on experimentation, as 0.5, although the invention is not limited in scope in this respect. It is noted that other weights may be employed and provide satisfactory results. At the same time the weights assigned to vertical neighboring green pixel signal values have been chosen as 0.1, although the invention is not limited in scope in this respect.** On the basis of the above discussion the missing green pixel signal values in this particular pixel location is estimated as

$G_{m,n} = [\ 0.5 * (G_{m,n-1} + G_{m,n+1}) + 0.1 * (G_{m-1,n} + G_{m+1,n})\ ] / (0.5 + 0.5 + 0.1 + 0.1)$; or

$$G_{m,n} = 0.41667 * (G_{m,n-1} + G_{m,n+1}) + 0.08333 * (G_{m-1,n} + G_{m+1,n});$$

However, if the relative change in the horizontal direction is greater than the relative change in the vertical direction, in terms of pixel signal level for the green pixel signal values, then a reverse approach is employed. More particularly, the vertical green pixel signal values that are immediately adjacent to the red pixel signal value, in this particular embodiment, are weighed more heavily. In particular, the green pixel signal value in this particular pixel signal location is estimated as follows.

$$G_{m,n} = 0.08333 * (G_{m,n-1} + G_{m,n+1}) + 0.41667 * (G_{m-1,n} + G_{m+1,n});$$

It is noted that the form of this equation is similar to the form above, except that the vertical and horizontal pixel signal values that are immediately adjacent to the red pixel signal value have been interchanged. Finally, if the two relative changes are equal, or substantially equal, then a simple average of the four green pixel signal values that are immediately adjacent to the red pixel signal value are averaged, for this embodiment, in accordance with the following equation.

$$G_{m,n} = 0.25 * (G_{m,n-1} + G_{m,n+1} + G_{m-1,n} + G_{m+1,n});$$

Therefore, in order to compute the signal value for the green color plane, where the particular pixel location has a pixel signal value in the red color plane, the pixel signal values immediately adjacent to that pixel location in the green color plane are compared. As shall be described in more detail below, it is not always the case that the color plane being computed corresponds to the particular color of the pixel signal values that are compared, although it is true in this embodiment for the situation just described." (Emphasis added.)

Also, as noted in the present application on page 5, first paragraph:

As previously indicated, unfortunately, many color interpolation techniques typically do not produce high-quality color images because the techniques employed typically do not take into account, or at least reasonably correctly take into account, how the human eye perceives color. ***For example, a typical color interpolation technique may include averaging the pixels adjacent to a particular pixel location in which it was desired to interpolate the color signal value for those colors not included in that pixel location of a subsampled color image.*** (Emphasis added.)

Utagawa fails to teach or suggest "relatively weighing the pixel signal values, the relative weights depending, at least in part, on the relative change of pixel signal value level in a particular direction and computing the color signal value based upon contributions from both directions." Rather, Utagawa teaches away from the present invention. In particular, in

Utagawa, when the interpolation processor recognizes that the calculations of the correlation amounts in the four directions are impossible, the average value of the pixel outputs of the grid points that are adjacent to the empty grid point becomes the interpolation amount. In particular, as noted in Utagawa at column 10, lines 11-62:

> FIG. 7 is a block diagram relating to second, third and fourth embodiments of the invention. In FIG. 7, devices that function the same as devices in the block diagram of the first embodiment shown in FIG. 2 are shown with the same symbols, and the explanation of such structure is omitted. The differences between the second, third and fourth embodiments and the first embodiment are that the interpolation processor 53 is provided instead of the interpolation processor 47. The interpolation processor 53 includes a correlation amount calculator 54, a weighting factor calculator 55 and an interpolation amount calculator 56.
>
> FIG. 8 is an operational flow chart of the interpolation processing of the second, third and fourth embodiments. Hereafter, the operation of the second embodiment is explained with reference to FIG. 7 and FIG. 8. The different characteristics of the present embodiment lie in the operation of the interpolation processing. Therefore, the explanations of other operations are omitted since they are the same as in the first embodiment.
>
> When the controller 40 recognizes that the release button is pressed, it designates the execution of the interpolation processing to the interpolation processor 53 within the signal processor 46. The interpolation processor 53, when thus instructed, selects the empty grid point which is to be the object of the interpolation processing, just like in the first embodiment (step S21).
>
> In the second-fourth embodiments, when the correlation amounts of the later mentioned four directions are calculated, it is desirable that at least two pixels exist in the four directions of upper, lower, left and right of the empty grid point. **For example, the evaluation of whether the calculations of the correlation amounts in four directions are possible corresponds to an evaluation of whether [3.ltoreq.k.ltoreq.X_max-2] and [3.ltoreq.p.ltoreq.Y_max-2] are established. The interpolation processor 53, by performing this kind of evaluation, evaluates whether the calculations of the correlation amounts in four directions is possible (step S22).**
>
> **When the interpolation processor 53, by doing this kind of evaluation, recognizes that the calculations of the correlation amounts in the four directions are impossible, the average value of the pixel outputs of the grid points that are adjacent to the empty grid point becomes the interpolation amount (step S23).** When the interpolation processor 53 recognizes that the calculations of the correlation amounts in the four directions are possible, it activates the correlation amount calculator 54, the weighting factor calculator 55 and the interpolation amount calculator 56. (Emphasis added.)

In view of the above, Applicants respectfully request that the claims be allowed to issue.

Claim Discussion – 35 U.S.C. §103 (a)

Claims 7-12 are patentable over Utagawa (US 6,563,538) in view of Hamilton (US 5,629,734) and Cok (US 4,642,678) for the same reasons noted above. There is also no suggestion to combine the two references.

CONCLUSION

In view of the foregoing, it is respectfully asserted that all of the claims pending in this patent application are in condition for allowance.

The required fee for a three month extension of time is enclosed. No additional fees are required for additional claims. Should it be determined that an additional fee is due under 37 CFR §§1.16 or 1.17, or any excess fee has been received, please charge that fee or credit the amount of overcharge to deposit account #02-2666.

If the Examiner has any questions, he is invited to contact the undersigned at (323) 654-8218. Reconsideration of this patent application and early allowance of all the claims is respectfully requested.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR, & ZAFMAN LLP

Dated: January 9, 2005

By _____
Farzad E. Amini, Reg. No. 42,261

12400 Wilshire Boulevard
Seventh Floor
Los Angeles, California 90025
(310) 207-3800

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage in an envelope addressed to: Mail Stop RCE, Commissioner for Patents, Post Office Box 1450, Alexandria, Virginia 22313-1450 on January 9, 2005.

_____
Margaux Rodriguez *January 9, 2005*